ARS-44-136
Dairy-Herd-Improvement Letter (Vol. 39, No. 7)

November-December 1963

4,000 SIRES SUMMARIZED IN NOVEMBER 1963

A total of 4,000 sires were summarized in November 1963, 23 percent of which represented bulls active in AI. The cooperating States were sent 10,169 sire records.

Fifty percent of the summarized AI sires maintained or increased milk yield and 56 percent maintained or increased fat yield. The corresponding values for non-AI sires were 48 and 52 percent, respectively. The results of the November 1963 summary are shown in Tables 2, 3, and 5.

A total of 16,899 summaries were included in the three evaluations for 1963. For each bull the average number of daughters with herdmates was 152 and 11 for AI and non-AI sires, respectively.

1,040,489 DHIA LACTATION RECORDS REPORTED IN PAST 10 MONTHS

New lactation records numbering 597,600 were reported and processed as a part of the July 1963 sire evaluation. The November 1963 evaluation included 542,889 newly reported records. During the 10 month period ending on September 15, 1963, 1,040,489 lactation records were reported, approximately 50 percent of which were via magnetic tape.

Issued January 1964

PUBLICATION OF HIGH-RANKING PROGENY OF AI SIRES (Cow Index Ratings)

Since 1962, superior progeny of bulls used in artificial service have been identified and published on the DHIA Sire Summary Record (DHIA-1202) of their sire. It has become apparent that more refined procedures for evaluating cows would be useful to the industry, and such procedures are now practical with the aid of high-speed computing facilities.

The evaluation of the breeding potential of cows provides another avenue of usage of production testing information collected in herds of dairymen participating in the National Cooperative Dairy Herd Improvement Program.

The evaluation of breeding values of registered daughters of AI sires will be based on the performance of the cow herself and that of her artificially sired paternal half-sisters. Lists will represent the top two percent of registered progeny of AI sires. These lists will have several avenues of usefulness to the industry. The cows identified will be the genetically most desirable animals resulting from AI in DHIA and DHIR herds. The information on these outstanding cows will be available for use by extension workers in their educational and demonstration programs in the States. The lists of cows will also be a means of locating sources of desirable breeding stock. Finally, this information can be an aid to the AI industry in increasing the rate of genetic progress in herds using AI.

Research indicates that about one-third of the total potential for genetic improvement can be realized by selection of the most outstanding cows available to produce the bulls to be used in future service. A number of AI organizations are actively pursuing programs of selected matings of top cows to the best AI-proven sires available. The USDA-DHIA list of high-ranking registered daughters of AI bulls will offer a useful means of identifying cows to be considered for such matings.

Calculation of the Cow Index Rating

Application of the principles of quantitative genetics provides many different ways of estimating the value of a cow for breeding use. There are many different sources of information on a cow's genetic worth available for animals in production-tested herds.

Registered progeny of AI sires are currently being screened exclusively on their own production superiority with respect to their contemporary herdmates. This information is published for the highest rated cows on the DHIA-1202 summary of the sire of the cow. No estimate of breeding value of cows is provided on these individual sire reports.

Production-tested relatives also provide additional information as to the merit of offspring a cow is likely to produce. Many different types of relatives may be available for an individual, such as maternal half-sisters, paternal half-sisters, full sisters, dam, daughters, etc. Generally, the closer the relationship, the more information a relative's performance provides on the genetic value of a cow.

Procedures for combining accurately the various types of information on relatives, together with the production of the cow herself, have been available for many years. The use of high-speed automatic data processing equipment now makes the screening of records of large numbers of animals practical.

The most useful single type of information on relatives available to shed light on a cow's breeding value is the performance of her artificially sired paternal half-sisters. This is true because AI paternal half-sisters can be very numerous, and because these paternal half-sisters will be scattered over many different levels of herd environment. Many other types of relatives are likely to have experienced similar environmental circumstances as the cow herself.

In view of the above consideration, and because information on other relatives is much more expensive to compile, the estimate of genetic value of cows in the USDA-DHIA list of high-ranking registered daughters of AI sires will be based only on the cow's own superiority over her herdmates and the average superiority over herdmates of her artificially sired paternal half-sisters.

Similar evaluations of progeny of bulls used solely in natural service are not available. The natural-service paternal half-sisters and the cow herself usually will have experienced similar environmental conditions. This means that natural-service paternal half-sisters do not provide nearly as much information about a cow's breeding value as an equal number of artificially sired sisters. For this reason only progeny of bulls with AI daughters will be evaluated.

The two types of information will be combined by the selection index procedure and hence, the result can be called the index of the cow's breeding value. The selection index method assures that the cow's own production and that of her paternal half-sisters are combined so that the resulting index of breeding value corresponds more closely to the cow's true genetic value than any other available criterion based on the same information.

The accompanying table is shown simply to demonstrate the relative importance of paternal half-sib information to records of the cow herself.

Number of Records		Weight		
Cow	Paternal Sisters	Cow	Paternal Sisters	Relative Emphasis
1	5	0.24	0.19	0.8
1	25	.22	.49	2.2
1	200	.20	.74	3.7
2	5	.33	.17	.5
2	25	.31	.43	1.4
2	200	.29	.66	2.3
4	5	.41	.15	.4
4	25	.38	.38	1.0
4	200	.36	.59	1.6

This table merely indicates the way in which the amounts of information available on the cow and her paternal sisters are balanced to alter the relative emphasis as more or less data from the two sources are used. The last column of the table gives the relative emphasis on the paternal-sib information as compared to the cow's own performance.

The index rating of the cow (both milk and butterfat production) will be expressed in terms of a difference from zero. Therefore, the best cow is the one with the highest positive index.

To illustrate the calculation of the index values, consider an example in which a cow has two DHIA lactation records available:

Cow's 305-2X-ME

Lactation	Record	Adj. Herdmate Average
1	12,287	11,058
2	12,995	11,216
Average	12,641	11,137

Suppose that this cow has 200 AI paternal half-sisters with an average deviation from their contemporaries of plus 361 pounds of milk. The proper weights are obtained and the index calculated as follows:

$$\text{Index} = 0.29\ (12{,}641\text{-}11{,}137) + 0.66\ (361) = 674 \text{ lbs.}$$

The index does not account for genetic differences which may exist between herds using AI. However, if such differences exist, they are likely to be small.

Description of List of Cow Index Ratings

An example of the listing which is to be printed and distributed is shown in Table 4. It should be noted that the format of this publication corresponds closely to that for listing cows on the DHIA-1202 Sire Summary Record.

In the first column the DHIA herd code of the last herd in which the cow made a record is given.

The next column lists the registration number of the cow. Canadian registrations are denoted by 9-digit numbers which contain an "01" in the left-most positions. Column 3 provides an indication as to whether the cow was conceived before or after her sire entered artificial service: An "A" indicates artificially sired; a blank indicates naturally sired.

The registration number of the cow's sire is given in the following column. Since all sires whose progeny appear on the Cow Index Listings have previously been summarized in DHIA, further information on the sire can be obtained from the latest edition of the DHIA Sire Summary List.

Next are presented the month, day, and year in which the cow was born. Following this are data on the average number and performance of the cow's herdmates, averaged over all of her individual lactations.

The average days in milk, the number of records of the cow, and her average milk, percent test, and butterfat production are presented next.

The "conditions affecting record" code (if any) of the cow's last available record is listed in the column after the cow's average butterfat yield. This code provides some clue as to whether a cow is still alive. If the cow was removed from the herd during the last available lactation, this is indicated by a "2" or "3" code in this column. A "2" indicates sold--presumably for dairy purposes, while a "3" indicates died or sold for slaughter.

In the final two columns are listed an index difference rating of the cow for milk and butterfat. The index is computed (see page 5) by multiplying a weight times the superiority of the cow over her herdmates and adding the result to the product of a second weight times the average superiority of her AI paternal half-sisters over their herdmates. The two weights mentioned above depend upon the number of records of the cow and the number of paternal half-sisters.

The listings will be separated by breed and will be arranged in herd code sequence. They will contain approximately the top two percent of registered daughters of AI sires summarized in DHIA and DHIR. The determination of cows to be listed will be based on the index rating for milk production. The lists are to be produced from results of DHIA sire summaries; therefore, a cow cannot be evaluated unless her sire was currently summarized. Since active AI sires are to be resummarized routinely, all registered daughters of these bulls would be eligible for listings.

The cow index ratings will be made available twice annually, beginning in 1964. Copies will be furnished to extension specialists and to AI organizations.

EXPANDED NURSE COW TABLE

It is frequently necessary to estimate monthly production credits of cows because of missing or spoiled milk samples, obvious abnormality, or temporary nurse cow status. The information used in estimating these monthly production credits in DHIA has been referred to as the nurse cow table. The table is based on the normal lactation curve (persistency) in which maximum rate of yield is normally reached during the second month of production and declines at an increasingly rapid rate thereafter.

In 1961, Van Vleck and Henderson of Cornell University, using ratio factor methods, provided a new set of factors for estimating missing monthly production credits. This study was based on 9,036 Holstein cows in 374 New York herds. These factors are shown in Table 1.

TABLE 1--MONTHLY TEST-DAY RECORD TO BE ESTIMATED

	1	2	3	4	5	6	7	8	9	10
Line 1	---	1.05	.95	.91	.90	.89	.85	.80	.67	.62
Line 2	.95	1.05	1.10	1.11	1.13	1.18	1.24	1.50	1.60	---
Line 3	---	.52	.51	.50	.50	.51	.50	.52	.47	---

Line 1 is applicable for estimating a missing test-day credit when the previous test-day milk weight is known. For example, if a cow produced 40 pounds of milk on the fourth test-day, the estimated yield for the fifth test-day is (40 x .90) or 36 pounds.

Line 2 is applicable when estimating a missing test-day credit if the <u>succeeding</u> test-day milk weight is known. For example, if a cow produced 70 pounds of milk on the second test-day, the estimated yield for the first month is (70 x .95) = 66.5 or 67 pounds.

Line 3 is used for estimating a missing test-day credit when <u>both preceding and succeeding</u> test-day milk weights are known. For example, if a cow produced 30 pounds of milk in the 7th month and 20 pounds of milk in the 9th month, the estimated yield for the 8th month is (30 + 20) x .52 = 26 pounds. Since this method is based on the normal lactation curve, it is more accurate than a simple average of the preceding and succeeding test-day weights, especially in early and late lactation.

Using Line 1 from the work of Van Vleck and Henderson, the DHIA nurse cow table has been revised and expanded to include a wider range in production. The resulting new nurse cow table is shown in Table 6, additional copies of which are available upon request.

The nurse cow table is expressed in pounds of daily milk yield. In estimating butterfat yield, DHIA Rule 14 is applicable and is as follows: "When a sample is lost, the previous month's butterfat test shall be used. When milk weights are not obtained, the pounds of milk for the current testing day shall be estimated from the previous month's record by use of the nurse cow table in the DHIA Supervisor's Manual. In either case, the record shall be marked "Estimated".

ERRATUM:

September-October 1963 Letter. The first sentence of the first paragraph on page 4 should read as follows: "Approximately 2.4 percent of the herds were producing below the above levels for the respective breeds."

TABLE 2--PERFORMANCE OF AI SIRES SUMMARIZED IN NOVEMBER 1963, AS MEASURED BY THE PRODUCTION OF PROGENY AND THEIR HERDMATES

Breed	Sires				Daughters Average Production			Herdmates Average Production		
	Total	Milk Yield Maintained or increased	Fat Yield Maintained or increased	Daughters with Herdmates	Milk	Test	Fat	Milk	Test	Fat
	No.	%	%	No.	Lbs.	%	Lbs.	Lbs.	%	Lbs.
Ayrshire	28	82	75	2,265	10,491	4.1	428	10,148	4.1	415
Guernsey	193	48	55	19,011	8,732	4.8	421	8,761	4.8	420
Holstein	493	49	56	121,310	12,939	3.7	478	13,012	3.7	478
Jersey	134	49	52	9,028	8,257	5.2	431	8,287	5.2	431
Brown Swiss	54	56	61	3,578	11,271	4.1	464	11,032	4.1	454
Milking Shorthorn	11	27	45	86	8,667	3.8	330	8,920	3.8	337
Overall	913	50	56	155,278	11,137	4.1	455	11,166	4.1	454

TABLE 3--PERFORMANCE OF NON-AI SIRES SUMMARIZED IN NOVEMBER 1963, AS MEASURED BY THE PRODUCTION OF PROGENY AND THEIR HERDMATES

Breed	Sires				Daughters Average Production			Herdmates Average Production		
	Total	Milk Yield Maintained or increased	Fat Yield Maintained or increased	Daughters with Herdmates	Milk	Test	Fat	Milk	Test	Fat
	No.	%	%	No.	Lbs.	%	Lbs.	Lbs.	%	Lbs.
Ayrshire	116	50	53	873	9,978	4.1	412	10,024	4.1	407
Guernsey	583	49	52	4,947	8,816	4.8	427	8,818	4.8	424
Holstein	1,842	48	51	15,201	12,981	3.7	478	13,012	3.7	477
Jersey	387	48	53	3,411	8,118	5.3	427	8,173	5.2	425
Brown Swiss	114	54	59	1,020	11,262	4.2	472	11,141	4.1	459
Milking Shorthorn	34	59	56	307	8,915	3.8	342	8,742	3.8	334
Overall	3,076	48	52	25,759	11,358	4.0	458	11,379	4.0	456

TABLE 4--HIGH-RANKING PROGENY OF AI SIRES
(Example for illustration only)

Herd Code	Cow Number	AI	Sire Number	Birth-date	Adj. Herdmate Average			Production of Cow					CAR	Cow Index	
					Herd-mates	Milk	Fat	Days	Lacta-tions	Milk	Test	Fat		Milk	Fat
					No.	Lbs.	Lbs.	No.	No.	Lbs.	%	Lbs.		Lbs.	Lbs.
21129875	3646349	A	955619	12- 1-52	10	13,434	503	301	3	23,273	3.7	854		3,703	134
21230937	4541969	A	1112211	11- 6-57	36	13,715	469	305	3	23,960	3.1	745		4,303	119
21290886	4227550		1112211	12-10-53	24	14,728	524	305	3	23,910	3.7	891		3,952	149
21309014	4368751	A	1240125	11-26-56	10	13,160	492	305	3	23,410	3.7	867		4,073	148
23050168	4299248	A	1056882	2-28-54	16	12,908	483	305	2	26,210	3.1	811		3,773	92
33310342	4795039	A	1090340	9-12-57	10	13,161	480	305	2	23,310	3.5	825		3,775	130
33450714	4424683	A	1090340	2-11-55	8	13,243	526	305	2	23,710	3.4	817		3,866	115
35790133	3466941	A	1038509	4-26-51	15	13,824	503	305	3	23,197	3.3	777		3,890	112
51140027	3528007		1077788	5- 7-52	8	9,504	359	305	3	20,177	3.4	691		4,098	126
82360176	3799324	A	1123249	8- 2-53	4	13,554	471	286	5	22,444	3.2	729	3	3,835	118

TABLE 5--NUMBER OF SIRE RECORDS SUMMARIZED NOVEMBER 1963, BY STATE, BY BREED

State	Ayrshire	Guernsey	Holstein	Jersey	Brown Swiss	Shorthorn	Total
	Number	Number	Number	Number	Number	Number	Number
Maine	8	29	89	21	4	5	156
New Hampshire	19	26	82	25	3	2	157
Vermont	22	49	177	66	15		329
Massachusetts	24	47	149	32	18	1	271
Rhode Island	9	6	47	2			64
Connecticut	17	63	116	20	21		237
New York	42	91	546	66	28		773
New Jersey	2	59	131	17	13		222
Pennsylvania	33	213	542	77	31	5	901
Ohio	13	68	226	73	38	3	421
Indiana	4	80	151	44	28	2	309
Illinois	16	94	213	30	40	5	398
Michigan	6	50	241	25	23	2	347
Wisconsin	9	91	383	25	52	10	570
Minnesota	15	63	248	26	29	8	389
Iowa	22	57	205	42	37	12	375
Missouri		45	88	25	8	3	169
North Dakota	1	10	37	3	10	1	62
South Dakota	5	3	59	7	8		82
Nebraska		22	84	5	10		121
Kansas	9	36	115	18	16	6	200
Delaware	3	15	60	5	6		89
Maryland	9	79	222	23	23	2	358
Virginia	7	78	221	25	12	3	346
West Virginia	8	20	81	16	1		126
North Carolina	6	56	145	42	15		264
South Carolina	1	48	82	32	15		178
Georgia	5	18	90	20	12		145
Florida	1	46	28	33	9		117
Kentucky		27	96	30	8		161
Tennessee	2	50	66	43	11	4	176
Alabama	2	28	54	37	5		126
Mississippi	8	38	20	42	4		112
Arkansas	3	15	30	7		4	59
Louisiana		35	22	7	2		66
Oklahoma	5	17	45	17	8	5	97
Texas	7	18	99	34	19		177
Montana	1	7	18	4	6	1	37
Idaho	1	35	66	28	8	3	141
Wyoming		2	14		1		17
Colorado	1	24	64	12	12		113
New Mexico		15	20	6			41
Arizona		17	31	6	4		58
Utah	2	18	91	10	2		123
Nevada		1	3	7			11
Washington	10	44	104	28	5		191
Oregon	1	49	61	45	4	4	164
California	1	39	53	17			110
Puerto Rico			10				10
Hawaii			1				1
Alaska			1		1		2
Total	144	780	2,339	521	170	46	10,169 1/ 4,000 2/

1/ Represents the number of individual sire records sent to States.
2/ Represents the number of sires summarized.

TABLE 6--NURSE COW TABLE [a/]

Estimated 305-day production	Estimated daily production for each testing period									
	1st	2d	3d	4th	5th	6th	7th	8th	9th	10th
4,360	20	21	20	18	16	15*	12	10*	6.6	4.1
4,550	21	22	21	19	17	15	13	10	7.0	4.3
4,790	22	23	22*	20*	18*	16*	14*	11*	7.2	4.5
5,030	23	24	23	21*	19*	17*	14	11	7.6	4.7
5,250	24	25	24*	22*	20*	17	15*	12*	7.9	4.9
5,430	25	26	25	23*	21*	18	16*	12	8.3	5.1
5,680	26	27	26*	24*	21	19*	16	13*	8.6	5.3
5,920	27	28	27	25*	22	20*	17*	13	9.0	5.6
6,070	28	29	28*	25	23*	20	17	14*	9.2	5.7
6,290	29	31*	29	26	24*	21	18	14	9.6	6.0
6,560	30	32*	30*	27	25*	22*	19*	15*	9.9	6.1
6,740	31	33*	31	28*	25	22	19	15	10.2	6.3
7,010	32	34*	32*	29	26	23	20*	16*	10.6	6.6
7,200	33	35*	33	30	27	24	20	16	10.9	6.8
7,440	34	36*	34*	31*	28*	25*	21	17*	11.3	7.0
7,630	35	37*	35	32*	29*	26*	22*	17	11.7	7.3
7,840	36	38*	36*	33*	29	26	22	18*	11.9	7.4
8,080	37	39*	37	34*	30	27	23	18	12.3	7.6
8,330	38	40*	38*	35*	31	28*	24*	19*	12.6	7.8
8,480	39	41	39	36*	32	29*	24	19	13.0	8.1
8,720	40	42	40*	36	33*	29	25*	20*	13.3	8.2
8,900	41	43	41*	37	34*	30*	25	20	13.5	8.4
9,180	42	44	42*	38	34	31*	26*	21*	13.9	8.6
9,400	43	45	43*	39	35	31	27*	21	14.2	8.8
9,610	44	46	44*	40*	36*	32*	27	22*	14.4	8.9
9,820	45	47	45*	41*	37*	33*	28*	22	14.8	9.2
10,030	46	48	46*	42*	38*	34*	29*	23*	15.3	9.5
10,250	47	49	47*	43*	38	34	29	23	15.6	9.7
10,490	48	50	48*	44*	39	35*	30*	24*	15.9	9.9
10,650	49	52*	49*	45*	40	36*	30	24	16.2	10.0
10,920	50	53*	50*	45	41*	36	31*	25*	16.5	10.2
11,170	51	54*	51*	46	42*	37	32*	25	16.9	10.5
11,350	52	55*	52*	47	43*	38*	32	26*	17.2	10.7
11,590	53	56*	53*	48	43	39*	33*	26	17.6	10.9
11,780	54	57*	54*	49	44	39	33	27*	17.8	11.0
11,990	55	58*	55*	50	45	40	34	27	18.3	11.3
12,290	56	59*	56*	51*	46*	41*	35*	28*	18.6	11.5
12,440	57	60*	57*	52*	47*	42*	35	28	18.9	11.7
12,660	58	61*	58*	53*	47	42	36*	29*	19.2	11.9
12,870	59	62	59*	54*	48	43*	37*	29	19.6	12.2
13,120	60	63	60*	55*	49	44*	37	30*	19.9	12.3
13,300	61	64	61*	55	50*	44	38*	30	20.2	12.5
13,540	62	65	62*	56	51*	45	38	31*	20.5	12.7
13,730	63	66	63*	57	52*	46*	39*	31	20.8	12.9
13,970	64	67	64*	58	52	47*	40*	32*	21.2	13.1
14,150	65	68	65*	59	53	47	40	32	21.6	13.4

[a/] See footnote at end of table.

TABLE 6--NURSE COW TABLE (Continued)

Estimated 305-day production	Estimated daily production for each testing period									
	1st	2d	3d	4th	5th	6th	7th	8th	9th	10th
14,430	66	69	66*	60*	54*	48	41*	33*	21.8	13.5
14,610	67	70	67*	61*	55*	49*	42*	33	22.2	13.8
14,850	68	71	68*	62*	56*	49	42	34*	22.5	14.0
15,040	69	73*	69*	63*	56	50	43*	34	22.9	14.2
15,280	70	74*	70*	64*	57	51*	43	35*	23.2	14.4
15,560	71	75*	71*	65*	58	52*	44*	35	23.5	14.6
15,710	72	76*	72*	65	59*	52	45*	36*	23.9	14.8
15,920	73	77*	73*	66	60*	53	45	36	24.2	15.0
16,170	74	78*	74*	67	61*	54*	46*	37*	24.5	15.2
16,350	75	79*	75*	68	61	55*	46	37	24.9	15.4
16,590	76	80*	76*	69	62	55	47	38*	25.2	15.6
16,840	77	81*	77*	70	63	56	48*	38	25.6	15.9
17,050	78	82*	78*	71*	64*	57*	48	39*	25.9	16.1
17,230	79	83	79*	72*	65*	58*	49*	39	26.2	16.2
17,420	80	84	80*	73*	65	58	49	40*	26.5	16.4
17,690	81	85	81*	74*	66	59*	50	40	26.9	16.7
17,900	82	86	82*	74	67	60*	51*	41*	27.2	16.9
18,090	83	87	83*	75	68*	60	51	41	27.5	17.1
18,330	84	88	84*	76	69*	61	52*	42*	27.8	17.2
18,540	85	89	85*	77	70*	62*	53*	42	28.2	17.5
18,790	86	90	86*	78	70	63*	53	43*	28.5	17.7
18,970	87	91	87*	79	71	63	54*	43	28.8	17.9
19,180	88	92	88*	80*	72*	64	54	44*	29.1	18.0
19,430	89	94*	89*	81*	73*	65*	55	44	29.5	18.3
19,670	90	95*	90*	82*	74*	65	56*	45*	29.8	18.5
19,860	91	96*	91*	83*	74	66	56	45	30.2	18.7
20,130	92	97*	92*	84*	75	67*	57*	46*	30.5	18.9
20,280	93	98*	93*	84	76	68*	57	46	30.8	19.1
20,500	94	99*	94*	85	77*	68	58	47*	31.2	19.3
20,770	95	100*	95*	86	78*	69	59*	47	31.5	19.5
20,950	96	101*	96*	87	78	70*	59	48*	31.8	19.7
21,170	97	102*	97*	88	79	71*	60	48	32.2	20.0
21,410	98	103*	98*	89	80	71	61*	49*	32.5	20.2
21,590	99	104*	99	90*	81*	72	61	49	32.8	20.3
21,840	100	105	100*	91*	82*	73*	62*	50*	33.1	20.5
22,910	105	110	105*	95	86	76	65	52	34.8	21.6
24,000	110	116	110*	100*	90*	80*	68*	54	36.4	22.6
25,100	115	121*	115*	104	94	84*	71	57*	38.1	23.6
26,170	120	126	120*	109*	98	87	74	59	39.7	24.6
27,270	125	131	125*	113	102	91	77	62*	41.5	25.7

a/ See The Supervisor's Manual, page 20, for instructions for using the table. The numbers marked with an asterisk (*) were raised to the nearest whole number.

Factors used for this table were developed by Dr. L. D. Van Vleck and Dr. C. R. Henderson, Cornell University, Ithaca, New York.